

## What Supergranule Flow Models tell us about the Sun's Surface Shear Layer and Magnetic Flux Transport

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Models of the photospheric flows due to supergranulation are generated using an evolving spectrum of vector spherical harmonics up to spherical harmonic wavenumber  $l \sim 1500$ . Doppler velocity data generated from these models are compared to direct Doppler observations from SOHO/MDI and SDO/HMI. The models are adjusted to match the observed spatial power spectrum as well as the wavenumber dependence of the cell lifetimes, differential rotation velocities, meridional flow velocities, and relative strength of radial vs. horizontal flows. The equatorial rotation rate as a function of wavelength matches the rotation rate as a function of depth as determined by global helioseismology. This leads to the conclusions that the cellular structures are anchored at depths equal to their widths, that the surface shear layer extends to at least 70 degrees latitude, and that the poleward meridional flow decreases in amplitude and reverses direction at the base of the surface shear layer ( $\sim 35$  Mm below the surface). Using the modeled flows to passively transport magnetic flux indicates that the observed differential rotation and meridional flow of the magnetic elements are directly related to the differential rotation and meridional flow of the convective pattern itself. The magnetic elements are transported by the evolving boundaries of the supergranule pattern (where the convective flows converge) and are unaffected by the weaker flows associated with the differential rotation or meridional flow of the photospheric plasma.